

Instructor Name:*عبدالله بن محمد*.....

Section: ...*2-3*...

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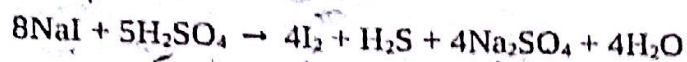
Useful data: $N_A = 6.02 \times 10^{23}/\text{mol}$; $T(\text{K}) = T(^{\circ}\text{C}) + 273$;

$R = 8.315 \text{ J/mol.K} = 0.0821 \text{ L.atm/mol.K}$; $u_{\text{rms}} = \sqrt{3RT/M}$

ANSWER SHEET

- | | | | | | | | | | | | |
|----|--------------|--------------|--------------|--------------|--------------|-----|---|--------------|--------------|--------------|--------------|
| 1. | a | b | c | d | e | 9. | a | b | c | d | e |
| 2. | a | b | c | d | e | 10. | a | b | c | d | e |
| 3. | a | b | c | d | e | 11. | a | b | c | d | e |
| 4. | a | b | c | d | e | 12. | a | b | c | d | e |
| 5. | a | b | c | d | e | 13. | a | b | c | d | e |
| 6. | a | b | c | d | e | 14. | a | b | c | d | e |
| 7. | a | b | c | d | e | 15. | a | b | c | d | e |
| 8. | a | b | c | d | e | 16. | a | b | c | d | e |

Q1) In the following reaction, which atom is oxidized?



- a) Na b) H c) O d) I e) S

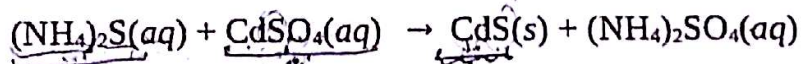
Q2) What mass of solute, in g, is contained in 356 mL of a 0.895 M ammonium chloride, NH_4Cl , solution? (Molar mass of NH_4Cl = 53.5 g/mol)

- a) 12.3 b) 26.6 c) 17.0 d) 30.5 e) 21.8

Q3) A 51.24-g sample of $\text{Ba}(\text{OH})_2$ is dissolved in enough water to make 1.20 L of solution. How many mL of this solution must be diluted with water in order to make 1.00 L of 0.120 M $\text{Ba}(\text{OH})_2$? (Molar mass of $\text{Ba}(\text{OH})_2$ = 171.3 g/mol)

- a) 643 b) 482 c) 278 d) 562 e) 401

Q4) Calculate the mass in g of cadmium sulfide, CdS , precipitated when 250.0 mL of 0.15 M $(\text{NH}_4)_2\text{S}$ solution is mixed with 120.0 mL of 0.063 M CdSO_4 . Molar mass of CdS = 144.4 g/mol. The balanced equation for the reaction is: 75.6



- a) 1.7 b) 1.3 c) 0.92 d) 1.5 e) 1.1

Q5) A 0.207-g sample of an unknown monoprotic acid is titrated to the end point using 35.2 mL of 0.106 M NaOH . Calculate the molar mass, in g/mol, of the acid.

- a) 82.3 b) 136 c) 55.5 d) 151 e) 109

Q6) Calculate the number of moles of an ideal gas contained in a cylinder with volume of 1.81 L at a pressure of 177 atm and temperature of 25°C. $\rightarrow 25 + 273$

- a) 13.1 b) 16.5 c) 10.9 d) 14.6 e) 18.3

Q7) Calculate the density, in g/L, of CO₂ gas at 27 °C and 0.70 atm pressure. Molar mass of CO₂ = 44.01 g/mol.

- a) 1.3 b) 0.21 c) 1.6 d) 0.89 e) 0.54

Q8) Which of the following statement about Kinetic Molecular Theory of gases is correct?

- a) At a given temperature, molecules with a greater molar mass will have a higher average kinetic energy.
 b) As the temperature of a gas increases, the average kinetic energy decreases.
 c) The average kinetic energy of a gas is dependent on temperature, molar mass, and speed.
 d) Molecules with a greater molar mass will have a higher speed.
 e) The most probable speed increases as temperature increases.

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

Q9) What is the molar mass, in g/mol, of a gas that effuses through a small hole twice faster the rate of chlorine gas, Cl₂, at the same temperature? Molar mass of Cl₂ = 70.9 g/mol.

- a) 38.5 b) 17.7 c) 14.2 d) 24.6 e) 64.0

Q10) Calculate the root-mean-squared speed, u_{rms} , of oxygen, O₂, molecules in a sample at 25°C. Molar mass of O₂ = 32.00 g/mol.

- a) 442 m s⁻¹ b) 681 m s⁻¹ c) 515 m s⁻¹ d) 482 m s⁻¹ e) 593 m s⁻¹

$\sqrt{3R}$

Q11) Which one of the following statements is false?

- a) The change in internal energy, ΔU , for a process is equal to the amount of heat absorbed at constant volume, q_v .
- b) The change in enthalpy, ΔH , for a process is equal to the amount of heat absorbed at constant pressure, q_p .
- c) If q_p for a process is negative, the process is exothermic.
- d) The freezing of water is an example of an exothermic process.
- e) Work is a state function.

Q12) Calculate the work, in (L . atm), associated with the expansion of a gas from 152.0 L to 189.0 L at a constant pressure of 16.0 atm.

- a) -666
- b) -518
- c) -444
- d) 592
- e) -359

Q13) A 140.0-g sample of water at 25.0°C is mixed with 80.0 g of a certain metal at 100.0°C. After thermal equilibrium is established, the final temperature of the mixture is 29.6°C. What is the specific heat of the metal? Specific heat of water = 4.184 J/g°C.

- a) 0.38 J/g°C
- b) 0.77 J/g°C
- c) 0.48 J/g°C
- d) 0.89 J/g°C
- e) 0.55 J/g°C

$$q = -q$$

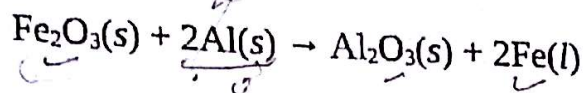
$$m_s \Delta t = -m_m \Delta t$$

~~$$140 \times (29.6 - 25) = -80 \times 4.184 \times (29.6 - 100)$$~~

Q14) The ΔH value for the reaction $(1/2)O_2(g) + Hg(l) \rightarrow HgO(s)$ is -90.8 kJ/mol. How much heat is released when 22.5 g Hg is reacted with excess oxygen? Molar mass of Hg = 200.6 g/mol.

- a) -23.8 kJ
- b) -10.2 kJ
- c) -30.2 kJ
- d) -19.2 kJ
- e) -14.7 kJ

Q15) Determine the standard enthalpy change $\Delta H^\circ_{\text{rxn}}$, in kJ/mol, for the reaction of Fe_2O_3 with aluminum metal according to the equation:

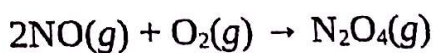


Given the following::

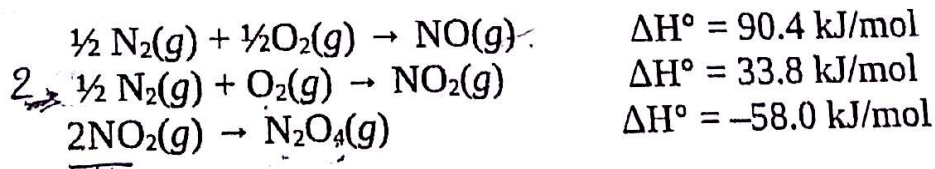
Substance	ΔH_f° kJ/mol
$\text{Fe}_2\text{O}_3(\text{s})$	-825.5
$\text{Al}_2\text{O}_3(\text{s})$	-1675.7
$\text{Fe}(\text{l})$	12.4

- a) -931.8 b) -657.1 c) 825.4 d) -460.0 e) -754.0

Q16) calculate the standard enthalpy change, $\Delta H^\circ_{\text{rxn}}$, in kJ/mol, for the the following reaction:



Using the following thermochemical data:



- a) 171.2 b) -114.6 c) 114.6 d) -171.2 e) 88.6

كل الشكر للطالبه

انيسه ابو ارشيد

على حل الاسئله

Q₁ :-

(d) I

Q₂ :-

$$0.895 \frac{\text{mol}}{\text{L}} * 0.356 \text{L} * \frac{53.5 \text{g}}{\text{mol}}$$

(c) 17.0 g



Q₃ :-

$$M_i \cdot V_i = M_f \cdot V_f$$

↓
??

$$51.24 \text{g} * \frac{\text{mol}}{171.3 \text{g}} = 2.991 \text{ (No. of mols of Solute)}$$

$$M_i = \frac{2.991}{1.20} = 2.49 \text{ mol/L}$$

$$M_i \cdot V_i = M_f \cdot V_f$$
$$2.49 \times V_i = 1.20 \times 1 \Rightarrow$$

$$V_i = \frac{2.49}{1.20}$$
$$= 2.075 \text{ L} \times 10^3 \frac{\text{ml}}{\text{L}}$$

(b) 482

Q4:-

$$0.063 \frac{\text{mol}}{\text{L}} * 9.120 \text{L} * 144.4 \frac{\text{g}}{\text{mol}}$$

Ⓒ 1.1 g

Q5:-

$$0.106 \frac{\text{mol}}{\text{L}} * 9.0352 \text{L} = 0.9573 \text{ mol}$$

of NaOH which =
No. of mols of acid

molar mass = $\frac{0.207}{0.00373}$

Ⓒ 55.5

Q6:-

$$PV = nRT$$

$$(177)(1.81) = n (0.0821)(25 + 273)$$

Ⓐ 13.1

Q7 :-

$$P \times \text{molar mass} = d \times R \times T$$

$$(0.70)(44.01) = d (0.0821)(27+273)$$

(a) 1.3

Q8 :-

(e)

Q9 :-



Suppose that \Rightarrow Unknown gas has r_1
 Cl_2 gas has r_2

From question $r_1 = 2r_2$.

$$\frac{r_1}{r_2} = \sqrt{\frac{\text{molar mass 2}}{\text{molar mass 1}}} \Rightarrow \frac{2r_2}{r_2} = \sqrt{\frac{\text{molar mass 2}}{\text{molar mass 1}}}$$

$$4 (\text{Molar mass}_1) = \text{Molar mass 2} \\ = 70.9$$

$$\text{molar mass 1} = \frac{70.9}{4}$$

(b) 17.7.

Q₃₀ :-

(d) 482

$$\overline{U}_{\text{rms}} = \sqrt{\frac{3RT}{M}}$$

$$= \sqrt{\frac{3 * (0.0821) * (25 + 273)}{2032 * 10^{-3}}}$$

Q₁₁ :-

(e)



Q₁₂ :-

$$W = -P \Delta U$$

$$W = - (16.0) (189.0 - 152.0)$$

(d) -592

Q13 :-

$$ms\Delta T = -ms\Delta T$$

$$80(s)(29.6 - 100) = -[140.0(4.184)(29.6 - 25.0)]$$

(c) $0.49 \text{ J/g}\cdot^{\circ}\text{C}$

Q14 :-

$$22.5 \text{ g} \times \frac{\text{mol}}{200.6 \text{ g}} = 0.112 \text{ mol}$$

$$-90.8 \frac{\text{kJ}}{\text{mol}} \times 0.112 \text{ mol}$$

(b)

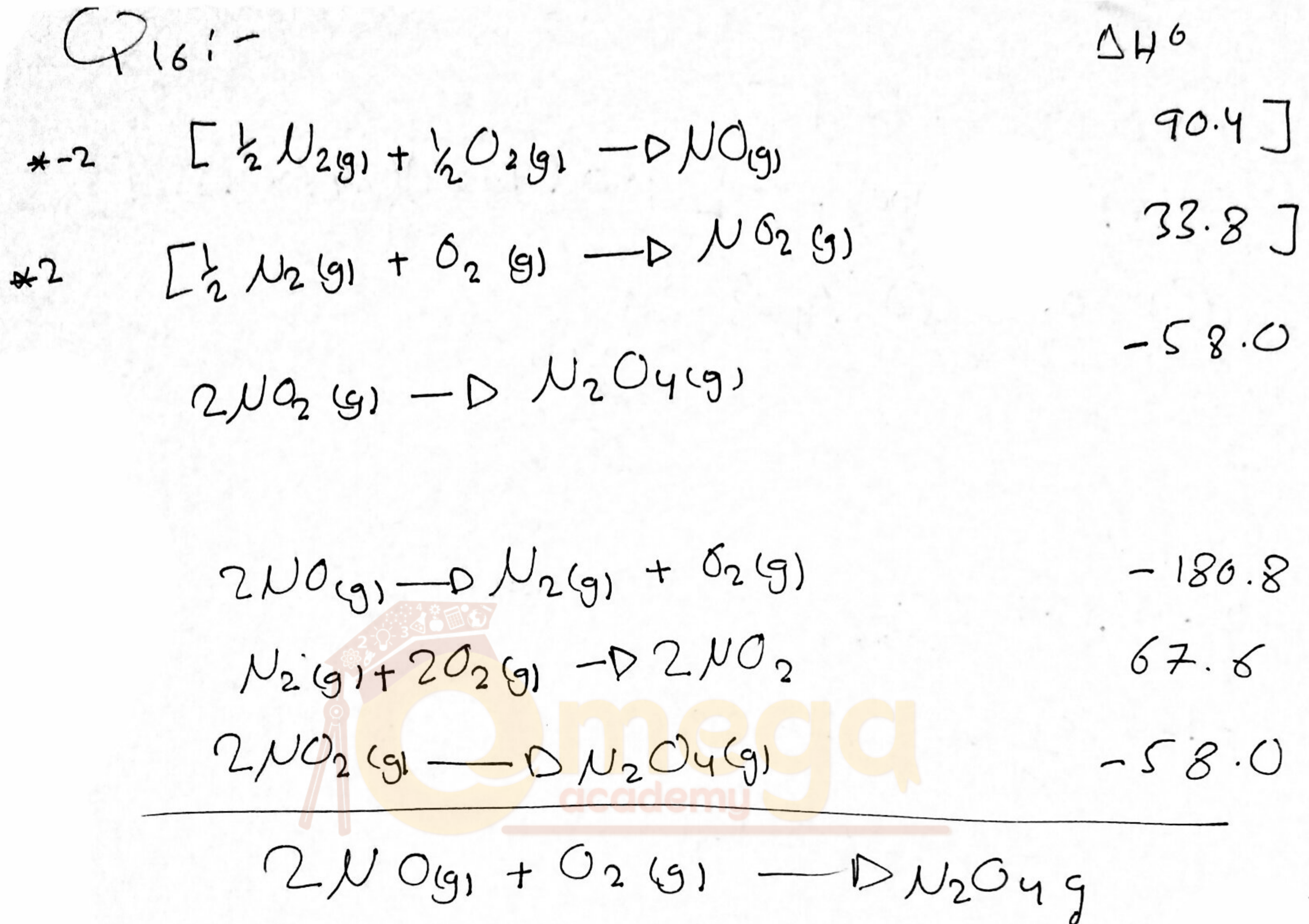
$$-10.2 \text{ kJ}$$

Q15 :-

$$\Delta H_{\text{rxn}}^{\circ} = n \Delta H_{\text{F}}^{\circ}(\text{Products}) - m \Delta H_{\text{F}}^{\circ}(\text{Reactant})$$
$$= 2(12.4) + (-1675.7) - [-825.5]$$

(c) -825.4

Q16:-



(J) -171.2

CHEMISTRY 101

Second EXAM

DEPARTMENT OF CHEMISTRY

70 MIN

December 6, 2014

NAME محمد رزق SECTION REGISTRATION No. 0139762

- 1) a b c ~~d~~ e f 14) a b ~~c~~ d e f
- 2) a ~~b~~ c d e f 15) a b c d ~~e~~ f
- 3) ~~a~~ b c d e f 16) a b c ~~d~~ e ~~f~~
- 4) a b ~~c~~ d e f 17) a ~~b~~ c d ~~e~~ f
- 5) ~~a~~ ~~b~~ c d e f 18) a ~~b~~ c d e ~~f~~
- 6) a b c d ~~e~~ f 19) a b ~~c~~ d ~~e~~ f
- 7) a b c ~~d~~ e f 20) ~~a~~ ~~b~~ c d e f
- 8) ~~a~~ b c d e f 21) a b c ~~d~~ e ~~f~~
- 9) a b c d ~~e~~ ~~f~~ 22) a b ~~c~~ d e f
- 10) a b c ~~d~~ e f 23) a b c ~~d~~ e f
- 11) a ~~b~~ ~~c~~ d e f 24) ~~a~~ ~~b~~ c d e f
- 12) a b ~~c~~ ~~d~~ e f 25) a b ~~c~~ ~~d~~ e f
- 13) ~~a~~ b c d e f 26) a b c ~~d~~ e f

Answer each of the following questions and put X on the correct choice on the front page:

1) Calculate the molarity of a solution of 7.57 g of methanol (CH₃OH, Molar mass = 32.0 g/mol) in 1.50 x 10² mL of solution.

- a) 0.952 b) 1.16 c) 1.37 **(d) 1.58** e) 1.79 f) 1.99

$$M = \frac{m/M_m}{V} = \frac{7.57/32.0}{1.50 \times 10^2 \times 10^{-3}} = \frac{0.2365625}{0.15} = 1.577 \times 10^0 = 1.58$$

2) Calculate the volume (in mL) of 5.0 M solution H₂SO₄ that are required to prepare 453 mL 0.32 M H₂SO₄ solution

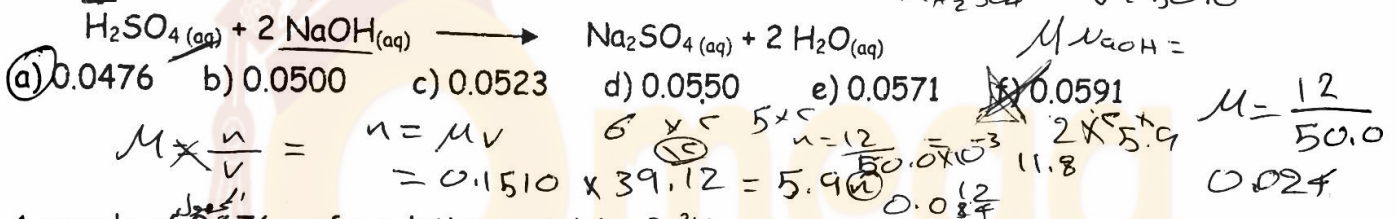
- a) 27 **(b) 29** c) 31 d) 33 e) 35 f) 37

$$M_1 V_1 = M_2 V_2$$

$$5.0 \times V_1 = 0.32 \times 453$$

$$V_1 = \frac{0.32 \times 453}{5.0} = 28.9 \text{ mL}$$

3) Calculate the concentration (in M) of 50.0 mL of H₂SO₄ solution which is needed to neutralize 39.12 mL of 0.1510 M NaOH solution



4) A sample of 0.676 g of a solution containing Ba²⁺ ions is treated with an excess Na₂SO₄ to produce 0.3605 g BaSO₄ precipitate. What is the percent by mass (%) of Ba²⁺ in the original sample?

(Molar mass of Ba = 137.3 g/mol and for BaSO₄ = 233.4 g/mol)

- a) 23.5 b) 27.0 **(c) 31.4** d) 35.7 e) 40.1 f) 44.4

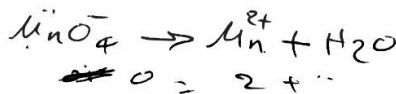
$$\text{Ba} \% = \frac{137.3}{233.4} \times 100\% = 58.8\%$$

$$\text{mass Ba} \% = 58.8 + 0.3605 = 59.2$$

$$\text{mass} \% = \frac{59.2}{0.676} \times 100\%$$

5) When the reaction $\text{Fe}^{2+}(\text{aq}) + \text{H}^+(\text{aq}) + \text{MnO}_4^-(\text{aq}) \rightarrow \text{Fe}^{3+}(\text{aq}) + \text{Mn}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$ is balanced in acidic solution, the coefficient of Mn²⁺ is

- ~~a) 1~~ **(b) 2** c) 3 d) 4 e) 5 f) 8



6) Which of the following statements is correct about Boyle's law?

- a) $\frac{V}{T} = \text{constant}$ b) $\frac{P}{V} = \text{constant}$ c) $\frac{V}{P} = \text{constant}$
 d) $\frac{V}{n} = \text{constant}$ **(e) PV = constant** f) $\frac{T}{V} = \text{constant}$

Boyles

Which of the following is not an assumption of the kinetic molecular theory of gases:

- a) The collisions between molecules are elastic.
- b) The gas molecules are in constant motion. $u \propto \sqrt{m}$
- c) The volumes of the gas molecules are negligible compared with the volume of the container.
- d) The gas molecules are in rapid motion.
- e) There are neither attractions nor repulsions between gas molecules.
- f) At a constant temperature, all the molecules have the same speed.

The standard temperature and pressure (STP) refers to

- a) 273 K and 1 atm
- b) 298 K and 1 atm
- c) 298 K and 1 mmHg
- d) 273 K and 1 pascal
- e) 273 K and 1 mmHg
- f) 273 F and 1 atm

How many moles of gas are there in a 45.0 L container at 25.0 °C and 590. mmHg? (760. mmHg = 1.00 atm, $R = 0.0821 \text{ L}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$, $T(\text{K}) = T(\text{C}) + 273$)

- a) 1.21
 - b) 1.28
 - c) 1.33
 - d) 1.38
 - ~~e) 1.43~~
 - f) 1.48
- Handwritten work: $PV = RNT$
 $\frac{360}{24.5} = \frac{760 \times 1 \text{ atm}}{590 \times x}$
 $760 \cdot x = 590$
 $x = \frac{590}{760} = 0.77 \text{ atm}$
 $n = \frac{0.77 \times 45.0}{0.0821 \times 298} = \frac{34.65}{24.46} = 1.417$

Calculate the density of NO₂ gas (g/L) in a tank at 1.5 atm and 5.0 °C (molar mass of NO₂ = 46.0 g/mol, $R = 0.0821 \text{ L}\cdot\text{atm}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$)

- a) 1.8
 - b) 2.2
 - c) 2.6
 - d) 3.0
 - e) 3.4
 - f) 3.8
- Handwritten work: $d = \frac{PM}{RT}$
 $46.0 = d \times 0.0821 \times 278$
 $3.0 = \frac{46.0}{15.21} = d \times \frac{15.21}{15.21}$
 $46.0 = d \times 22.82$

Which of the following gases will have the greatest rate of effusion at a given temperature? Molar mass: NH₃ = 17, CH₄ = 16, Ar = 40, HBr = 81.0, HCl = 36.5, N₂ = 28.0 g/mol

- a) NH₃ 17
 - b) CH₄ 16
 - c) Ar 40
 - d) HBr 81.0
 - e) HCl 36.5
 - f) N₂ 28.0
- Handwritten work: $r_1/r_2 = \sqrt{M_2/M_1}$
 $r = \sqrt{\dots}$

Calculate the root-mean-square speed (u_{rms}) of CO in (m/s) at 25 °C (Molar mass of CO = 28.0 g/mol, $R = 8.314 \text{ J}\cdot\text{mol}^{-1}\cdot\text{K}^{-1}$, $u_{\text{rms}} = \sqrt{\frac{3RT}{M}}$)

- a) 682
 - b) 612
 - ~~c) 515~~
 - d) 482
 - e) 442
 - f) 411
- Handwritten work: $25 + 273 = 298$
 $3 \times 8.314 \times 298$
 28.0

$$u_{\text{rms}} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \times 8.314 \times 298}{28.0}} = 265.45$$

16.2 x 707

13) C_2F_4 (Molar mass = 100.0 g/mol), effuses through a small opening at a rate of 4.6×10^{-6} mol/h. An unknown gas effuses at a rate of 5.8×10^{-6} mol/h under the same conditions. What is the molar mass of the unknown gas (in g/mol)?

- (a) 63 b) 53 c) 40. d) 35 e) 27 f) 22

$$\frac{r_1}{r_2} = \sqrt{\frac{M_2}{M_1}}$$

$$\left(\frac{4.6 \times 10^{-6}}{5.8 \times 10^{-6}}\right)^2 = \left(\frac{M_2}{100.0}\right)$$

$$0.62 \times \frac{100.0}{M_2} = 1.6$$

$$M_2 = \frac{100}{0.62} = 161.3$$

14) Which of the following conditions will give lowest deviation from ideal gas behavior?

- a) 100.0°C and 40. atm b) 0.0°C and 20. atm (c) 100.0°C and 1.0 atm
 d) -100.0°C and 40. atm e) -100.0°C and 20. atm f) -100.0°C and 1.0 atm

15) Which one of the following conditions would always result in an increase of the internal energy of a system?

- a) The system loses heat and does work on the surrounding
 b) The system gains heat and does work on the surrounding
 (c) The system loses heat and work is done by the surrounding on the system
 d) The system loses heat without doing any work
 (e) The system gains heat and work is done by the surrounding on the system
 f) The system does work on the surrounding

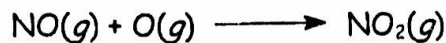
$$E = q + w$$

16) For which one of the following reactions will ΔH equal to ΔU ?

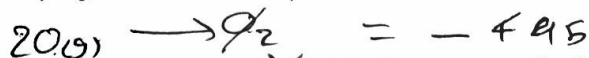
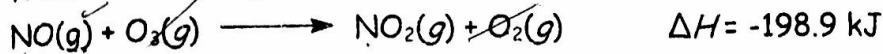
Solid - L

- a) $H_2O(l) \longrightarrow H_2O(g)$
 b) $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$
 c) $2H_2(g) + O_2(g) \longrightarrow 2H_2O(g)$
 (d) $H_2(g) + Br_2(g) \longrightarrow 2HBr(g)$
 e) $CH_4(g) + 2O_2(g) \longrightarrow CO_2(g) + 2H_2O(l)$
 (f) $H_2O(s) \longrightarrow H_2O(g)$

Calculate the enthalpy change (in kJ/mol) for the reaction



from the following data:



a) -324.1

~~b) -304.1~~

c) -284.1

d) -264.1

e) -294.1

f) -309.1

NO
 $\Delta H = -198.9 - (-495)$

$$\begin{array}{r} 296.1 \\ 306.1 \end{array}$$

18) Calculate the $\Delta H^\circ_{\text{rxn}}$ (in kJ/mol) for the following reaction.



$$\Delta H^\circ_f [\text{SiO}_2(s)] = -910.9 \text{ kJ/mol};$$

$$\Delta H^\circ_f [\text{SiCl}_4(g)] = -657.0 \text{ kJ/mol};$$

$$\Delta H^\circ_f [\text{HCl}(g)] = -92.3 \text{ kJ/mol};$$

$$\Delta H^\circ_f [\text{H}_2\text{O}(g)] = -248.8 \text{ kJ/mol}$$

$$\Delta H = \boxed{-1003.2} - \boxed{-905.8}$$

$$\begin{array}{r} 1909. \\ 97.4 \end{array}$$

161.5

b) 179.5

c) 147.5

d) 155.5

e) 139.5

~~f) 125.5~~

19) Calculate the heat of neutralization (kJ/mol) when 50.0 mL of 0.500 M HCl at 25.0°C is added to 50.0 mL of 0.500 M NaOH at 25.0°C in a coffee cup calorimeter, the temperature of the mixture rises to 28.7°C. Assume that the mixture has a specific heat of 4.18 J/g°C, the density of the reaction solution is 1.00 g/mL, and the calorimeter has negligible heat capacity.

a) -41.8

b) -43.5

c) -51.8

d) -55.2

~~e) -61.9~~

f) -65.2

$$q_{\text{mix}} = \frac{d \cdot V \cdot T}{t}$$

$$\begin{array}{l} M_f V_f T \\ \mu V, T \\ t, d \\ + \end{array}$$

20) Which of the following is not state function?

a) enthalpy

~~b) heat~~

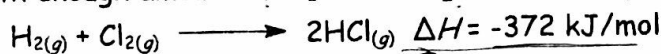
c) temperature

d) volume

e) energy

f) pressure

21) Calculate the heat (in kJ) released from the reaction of 75.0 g of Cl_2 (Molar mass of $\text{Cl}_2 = 70.9$ g/mol) with enough amount of H_2 according to the following reaction:



a) 131

b) 184

c) 236

d) 288

e) 341

~~f) 394~~

$$\Delta H = -372$$

$$n = \frac{m}{\text{molar}} = \frac{75.0}{70.9}$$

$$\Delta H = 1.08$$

22) What is the wavelength (in nm) of radiation that has a frequency of $6.11 \times 10^{14} \text{ s}^{-1}$?

$(c = \lambda\nu = 3.00 \times 10^8 \text{ m/s}) \quad \lambda = \frac{c}{\nu} = \frac{3.00 \times 10^8}{6.11 \times 10^{14}} \quad \lambda =$

- a) 434 b) 461 c) 491 d) 516 e) 554 f) 587

23) What is the energy (in J) of one photon of microwave radiation with a wavelength 0.211 m ?

$(h = 6.63 \times 10^{-34} \text{ J s}, E = h\nu, c = 3.00 \times 10^8 \text{ m/s}, c = \lambda\nu) \quad E = h\nu \quad c = \frac{c}{\lambda} \nu \quad \nu =$

- a) 1.09×10^{-24} b) 1.31×10^{-24} c) 1.63×10^{-24}
 (d) 9.43×10^{-25} e) 8.25×10^{-25} f) 7.62×10^{-25}
- $\frac{3.00 \times 10^8}{0.211}$

24) Atoms emit visible and ultraviolet light when

$6.63 \times 10^{-34} \times 1.5 \times 10^8 = 9.945 \times 10^{-26} \text{ J} \quad 1.5 \times 10^8$

- a) electrons drop from higher energy levels to lower levels.
 b) electrons jump from lower energy levels to higher levels.
 c) the atoms condense from a gas to a liquid.
 d) they are heated and the solid melts to form a liquid.
 e) the electrons move about the atom within an orbit.
 f) the electrons move around the nucleus of an atom.

25) Calculate the energy (in J) of the photon accompanied by moving an electron in a hydrogen atom from the $n = 6$ to the $n = 3$ principal energy levels. ($E_n = -2.18 \times 10^{-18} \text{ J}(1/n^2)$)

- a) -2.08×10^{-19} b) -1.55×10^{-19} ~~c) -1.82×10^{-19}~~
 (d) -1.02×10^{-19} e) -4.84×10^{-19} f) -5.01×10^{-19}

$= \frac{-2.18}{36 - 9} = -1.02$

26) In the hydrogen atom, which of the following transitions will result in the emission of the lowest energy photon?

- a) $n = 4 \rightarrow n = 1$ b) $n = 5 \rightarrow n = 1$ c) $n = 3 \rightarrow n = 1$
 (d) $n = 2 \rightarrow n = 1$ e) $n = 7 \rightarrow n = 1$ f) $n = 6 \rightarrow n = 1$

H_1 Zero
 $2 \rightarrow 1$

Name: Reg. No.:

Instructor and time..... Seat No.

Ideal gas equation: $PV = nRT$; $E_{\text{photon}} = hv$; $N = 6.022 \times 10^{23} \text{ mol}^{-1}$;
 $R(\text{gas constant}) = 0.08206 \text{ atm.L / mol.K}$; $h(\text{Planck's constant}) = 6.63 \times 10^{-34} \text{ J.s}$
 $c(\text{speed of light}) = 3.00 \times 10^8 \text{ m/s}$; $E(\text{for H atom}) = -(2.18 \times 10^{-18}/n^2) \text{ J}$;
 One nm = 10^{-9} m . ; $\lambda = h/mv$; $c = v\lambda$. atm.L = 101.3 J



ANSWER SHEET

- | | | | | | | | | | | | |
|----|---|---|---|---|---|-----|---|---|---|---|---|
| 1. | a | b | c | d | e | 9. | a | b | c | d | e |
| 2. | a | b | c | d | e | 10. | a | b | c | d | e |
| 3. | a | b | c | d | e | 11. | a | b | c | d | e |
| 4. | a | b | c | d | e | 12. | a | b | c | d | e |
| 5. | a | b | c | d | e | 13. | a | b | c | d | e |
| 6. | a | b | c | d | e | 14. | a | b | c | d | e |
| 7. | a | b | c | d | e | 15. | a | b | c | d | e |
| 8. | a | b | c | d | e | 16. | a | b | c | d | e |

1. The volume of a certain amount of a gas is 8.80 L at 127 °C and at pressure of 2.00 atm, calculate its volume at 27 °C and 6.00 atm.
a) 6.60 L b) 4.40 L c) 3.30 L d) 2.64 L e) 2.20 L

2. Calculate the density of CO₂ gas (in g/ L) at 25°C and 1.60 atm. Molar mass of CO₂ is 44.0 g/mol.
a) 2.52 b) 2.70 c) 2.88 d) 2.10 e) 2.34

3. A sample of 1.40 g of a vapor occupies 0.559 L at 97°C and 0.967 atm. Calculate the molar mass of the compound.
a) 98.3 b) 78.6 c) 124 d) 144 e) 112

4. A mixture of 0.260 moles O₂ and 0.540 moles N₂ has a total pressure of 4.00 atm. Calculate the partial pressure of O₂ in the mixture.
a) 1.30 atm b) 2.60 atm c) 3.25 atm d) 0.980 atm e) 1.95 atm

5. For the following gases (given molar masses):

F₂(38), Cl₂(71), O₂(32) and CO₂(44)

The order of increasing rate of effusion is:

- a) F₂ < Cl₂ < CO₂ < O₂ b) Cl₂ < F₂ < CO₂ < O₂
c) Cl₂ < O₂ < F₂ < CO₂ d) CO₂ < O₂ < F₂ < Cl₂
e) Cl₂ < CO₂ < F₂ < O₂

6. According to kinetic molecular theory, which of the following statements is correct?
- a) At same temperature gases with larger molar masses have lower average kinetic energies.
 - b) The volume occupied by an ideal gas particles cannot be neglected.
 - c) The pressure of the gas is due to the collisions of the gas particles with the walls of the container.
 - d) Ideal gas particles repel each other, but do not attract each another.
 - e) All above statements are wrong.
7. A gas is allowed to expanded from an initial volume of 2.00 L to a final volume of 11.00 L under a constant external pressure of 5.00 atm. The value of work, w , is;
- a) -1.82×10^3 J
 - b) -5.79×10^3 J
 - c) -2.74×10^3 J
 - d) -3.65×10^3 J
 - e) -4.56×10^3 J
8. Which one of the following reactions has ΔH equals to ΔE ?
- a) $\text{CaCO}_3(s) \rightarrow \text{CaO}(s) + \text{CO}_2(g)$
 - b) $\text{H}_2(g) + 1/2\text{O}_2(g) \rightarrow \text{H}_2\text{O}(l)$
 - c) $\text{CH}_4(g) + 2\text{O}_2(g) \rightarrow \text{CO}_2(g) + 2\text{H}_2\text{O}(l)$
 - d) $\text{H}_2(g) + \text{Cl}_2(g) \rightarrow 2\text{HCl}(g)$
 - e) $\text{H}_2\text{O}(l) \rightarrow \text{H}_2\text{O}(g)$
9. 50.0 mL of 0.500 M HCl at 25.0°C is added to 50.0 mL of 0.500 M NaOH at 25.0°C in a coffee cup calorimeter, the temperature of the mixture rises to 28.2°C. What is ΔH of neutralization per mole H_2O produced? Assume the mixture has a specific heat of 4.18 J/g·°C and a density of 1.00 g/mL. Assume the calorimeter to have zero heat capacity.
- a) -54 kJ/mol
 - b) -57 kJ/mol
 - c) -52 kJ/mol
 - d) -55 kJ/mol
 - e) -59 kJ/mol

10. Given the following thermochemical equations:



Calculate the enthalpy change for the reaction: $\text{NO}(g) + \text{O}(g) \rightarrow \text{NO}_2(g)$

- a) -302.1 kJ/mol b) -304.1 kJ/mol c) -308.1 kJ/mol
d) -306.1 kJ/mol e) -300.1 kJ/mol

11. Use the following data to calculate the standard enthalpy of formation, ΔH_f° , of manganese(IV) oxide, $\text{MnO}_2(s)$, in kJ/mol.



- a) -505 b) -512 c) -508 d) -516 e) -527

12. What is the wavelength of a photon of electromagnetic radiation whose frequency is $4.20 \times 10^{15} \text{ Hz}$.

- a) 71.4 nm b) 32.6 nm c) 98.4 nm d) 51.7 nm e) 41.7 nm

13. Calculate the wavelength of the wave associated with a proton (mass = $1.67 \times 10^{-24} \text{ g}$) moving at a speed of $1.90 \times 10^3 \text{ m/s}$

- a) 0.426 nm b) 0.209 nm c) 0.153 nm d) 0.137 nm e) 0.180 nm

14. Calculate the frequency (in Hz) of the electromagnetic radiation emitted by the hydrogen atom in undergoing a transition from the $n = 5$ level to the $n = 3$ level.

- a) 2.74×10^{14} b) 7.64×10^{14} c) 1.60×10^{14} d) 2.34×10^{14} e) 2.98×10^{14}

15. Which one of the following sets of quantum numbers is **not acceptable**?

- a) $n = 4, l = 3, m_l = -3, m_s = +1/2$
 b) $n = 4, l = 2, m_l = +2, m_s = -1/2$
 c) $n = 4, l = 4, m_l = +2, m_s = +1/2$
 d) $n = 4, l = 0, m_l = 0, m_s = -1/2$
 e) $n = 4, l = 1, m_l = 0, m_s = +1/2$

16. Which of the following is the correct electronic configuration of Se ($Z=34$)?

- a) $[\text{Ar}] 3d^{10} 4p^6$ b) $[\text{Kr}] 4s^2 3d^{10} 4p^4$ c) $[\text{Ar}] 4s^2 4p^4 4d^{10}$
 d) $[\text{Ar}] 4s^2 3d^{10} 4p^4$ e) $[\text{Ne}] 4s^2 3d^{10} 4p^4$

PERIODIC TABLE OF THE ELEMENTS

IA	IIA	IIIB	IVB	VB	VIB	VII B	VIII	IB	IIB	IIIA	IVA	VA	VIA	VIIA	0		
1 H 1.0079															2 He 4.0026		
3 Li 6.941	4 Be 9.0122									5 B 10.81	6 C 12.011	7 N 14.0067	8 O 15.9994	9 F 18.9984	10 Ne 20.179		
11 Na 22.9898	12 Mg 24.305									13 Al 26.9815	14 Si 28.086	15 P 30.9738	16 S 32.06	17 Cl 35.453	18 Ar 39.948		
19 K 39.098	20 Ca 40.08	21 Sc 44.9559	22 Ti 47.90	23 V 50.9414	24 Cr 51.996	25 Mn 54.9380	26 Fe 55.847	27 Co 58.9332	28 Ni 58.71	29 Cu 63.546	30 Zn 65.38	31 Ga 69.72	32 Ge 72.60	33 As 74.91	34 Se 78.96	35 Br 79.916	36 Kr 83.80
37 Rb 85.4678	38 Sr 87.62	39 Y 88.9059	40 Zr 91.22	41 Nb 92.9064	42 Mo 95.94	43 Tc 98.7062	44 Ru 101.07	45 Rh 102.9055	46 Pd 106.4	47 Ag 107.8682	48 Cd 112.40	49 In 114.82	50 Sn 118.69	51 Sb 121.75	52 Te 127.60	53 I 126.9045	54 Xe 131.30
55 Cs 132.9054	56 Ba 137.34	57 La 138.9055	72 Hf 178.49	73 Ta 180.9479	74 W 183.85	75 Re 186.2	76 Os 190.2	77 Ir 192.22	78 Pt 195.08	79 Au 196.9665	80 Hg 200.59	81 Tl 204.37	82 Pb 207.2	83 Bi 208.9804	84 Po (210)	85 At (210)	86 Rn (222)
87 Fr (223)	88 Ra 226.0254	89 Ac (227)															
			58 Ce 140.12	59 Pr 140.9077	60 Nd 144.24	61 Pm (147)	62 Sm 150.4										
								63 Eu 151.96	64 Gd 157.25	65 Tb 158.9254	66 Dy 162.50	67 Ho 164.930	68 Er 167.26	69 Tm 168.9342	70 Yb 173.04	71 Lu 174.97	
																	103

* LANTHANIDE SERIES

Solution:

1] $P_1 = 2 \text{ atm}, P_2 = 6 \text{ atm}$

$T_1 = 127 + 273 = 400 \text{ K}^\circ$

$T_2 = 27 + 273 = 300 \text{ K}^\circ$

$V_1 = 8.80 \text{ L}, V_2 = ?$

$$\frac{P_1 V_1}{T_1} = \frac{P_2 V_2}{T_2} \Rightarrow \boxed{V_2 = 2.20 \text{ L}} \quad \text{e)}$$

2] $T = 25 + 273 = 298 \text{ K}^\circ$

$$d = \frac{M_w P}{RT} = \frac{44 \times 1.6}{0.0821 \times 298} = \boxed{2.878} \quad \text{c)}$$

$$3] M_w = \frac{MRT}{PV} = \frac{1.4 \times 0.0821 (97 + 273)}{0.067 \times 0.559} = \boxed{78.6} \quad \text{b)}$$

4] $X_{O_2} = \frac{n_{O_2}}{n_{O_2} + n_{N_2}} = 0.8$

$P_{O_2} = X_{O_2} \times P_{\text{total}} = \boxed{1.3 \text{ atm}} \quad \text{a)}$

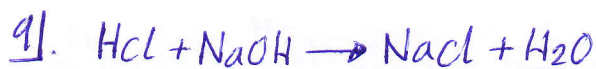
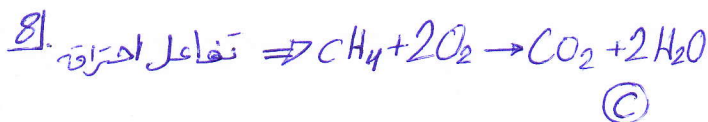
5] M_w (الكثافة المولية) effusion

$Cl_2 < CO_2 < F_2 < O_2 \quad \text{e)}$

6] c)

7] $V_1 = 2 \text{ L}, V_2 = 11 \text{ L}, P = 5 \text{ atm}$

$$W = -P\Delta V = -5(11-2) = -45 \text{ atm}\cdot\text{L} = -4.56 \times 10^3 \text{ J} \quad \text{e)}$$



$V_1 = 50 \text{ mL} = 0.05 \text{ L}, V_2 = 50 \text{ mL} = 0.05 \text{ L}$

$M = 0.5, M = 0.5$

$\Delta T = (28.2 - 25) = 3.2^\circ, \Delta H = ??$

$C = 0, SP = 4.18$

$$\Delta H = (SP \times m \times \Delta T) + (C \times \Delta T) = 4.18 \times 100 \times 3.2 = 1.337 \text{ kJ} = -1.337 \text{ KJ}$$

↓ exothermic

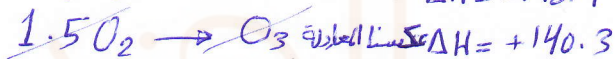
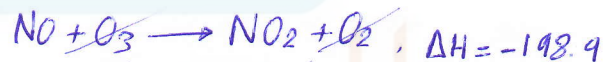
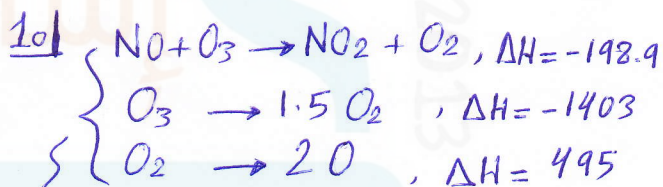
$m = d \times V_{\text{total}} = 1 \times (50 + 50) = 100 \text{ g}$

* HCl & NaOH L.R (تساوي الجزيئات).

$n_{H_2O} = n_{HCl} = M \times V = 0.5 \times 0.05 = 25 \times 10^{-3} \text{ mol}$

$25 \times 10^{-3} \text{ mol} \rightarrow 1.337 \text{ KJ}$

$1 \text{ mol} \rightarrow X \text{ KJ} \Rightarrow X = -54 \text{ KJ} \quad \text{a)}$



← ضربنا 1/2 وعكسنا المعادلة.

$$\Delta H_{\text{total}} = -198.9 + 140.3 - 147.5 = -306.1 \text{ KJ/mol} \quad \text{d)}$$

11] $-512 = \Delta H_f^\circ \quad \text{b)}$

12] $C = \lambda \times V = 3 \times 10^8, \lambda = \frac{c}{v} = \frac{3 \times 10^8}{4.2 \times 10^{15}} = 71.4 \text{ nm} \quad \text{a)}$

14] $\Delta E = A \left[\frac{1}{n_f^2} - \frac{1}{n_i^2} \right] = 2.178 \times 10^{-8} \left[\frac{1}{5^2} - \frac{1}{3^2} \right]$

$V = \frac{\Delta E}{h} = \frac{-1.5 \times 10^{-9}}{6.626 \times 10^{-34}} = -2.33 \times 10^{24}$

13] $v = 1.9 \times 10^3$, $m = 1.67 \times 10^{-27}$ kg

$$\lambda = \frac{h}{mv} = \frac{6.626 \times 10^{-34}}{1.67 \times 1.9 \times 10^3} = 2.08 \times 10^{-10} \text{ m}$$

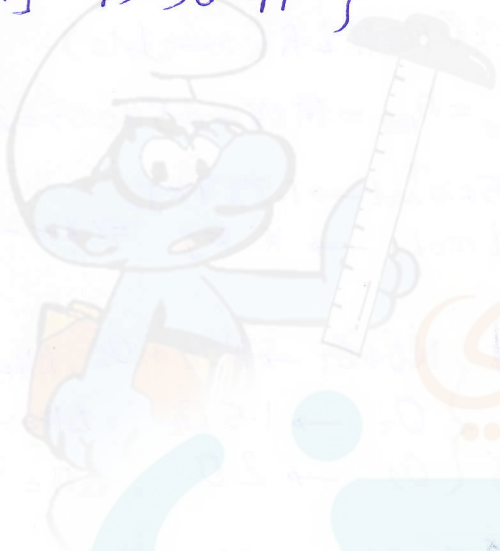
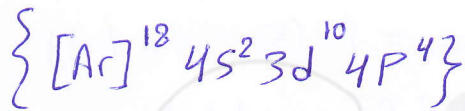
1.5] $n = 4$, $l = 4$, $m_l = 2$, $m_s = +\frac{1}{2}$

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{ لا يمكن ان تكون قيمة (L) مساوية لقيمة (n) }

1.6]

④



إسألني
2013
الهندسة

The University of Jordan
Date: 12/12/2010

General Chemistry 101
Second Exam

Chemistry Department
Time: 60 min.

Name: _____ Registration Number _____

Instructor _____ Seat No. _____ Day/Time _____

Answer Sheet

$K = ^\circ\text{C} + 273$, $1 \text{ atm} = 760 \text{ mmHg}$, $R = 0.082057 \text{ L.atm/(K.mol)} = 8.314 \text{ J/(K.mol)}$, $L.\text{atm} = 101.3 \text{ J}$, $N_A = 6.022 \times 10^{23}$, $h = 6.63 \times 10^{-34} \text{ J.s}$, $R_H = 2.18 \times 10^{-18} \text{ J}$,

$c = 3 \times 10^8 \text{ m/s}$, $PV = nRT$, $u_{\text{rms}} = \sqrt{u^2} = \sqrt{\frac{3RT}{M}}$, $KE = \frac{3}{2}RT = N_A \left(\frac{1}{2} m u^2 \right)$, $\Delta E = \Delta H - P\Delta V$

$\Delta E = q + w$, $c = \lambda\nu$, $E = h\nu$, $E_n = -R_H(1/n^2)$, $\lambda = h/(mu)$,

1. a b c d e 9. a b c d e

2. a b c d e 10. a b c d e

3. a b c d e 11. a b c d e

4. a b c d e 12. a b c d e

5. a b c d e 13. a b c d e

6. a b c d e 14. a b c d e

7. a b c d e 15. a b c d e

8. a b c d e 16. a b c d e

1] Determine the molar mass of a gas if 0.401 L weighs 1.55g at STP?

- a) 69.3 g/mol b) 94.5 g/mol c) 86.6 g/mol d) 53.3 g/mol e) 43.3 g/mol

2] In a reaction of calcium metal with water, the volume of hydrogen gas collected at 50°C and pressure of 988 mmHg is 441 mL. What is the mass (in grams) of the hydrogen gas obtained? The vapor pressure of water at 50°C is 118 mmHg. (Molar mass of H₂=2.016 g/mol)

- a) 0.0436g b) 0.0384g c) 0.0190g d) 0.0242g e) 0.0488g

3] Calculate the mass of calcium (in g) that must be dissolved in sulfuric acid in order to obtain 500ml of hydrogen gas at 20°C and 770 mmHg? (Molar mass of Ca = 40.08 g/mol)

- a) 1.38 g b) 0.0425 g c) 1.24 g d) 0.84 g e) 1.18 g



4] What is the kinetic energy of a mole of CO₂ at 200K (in kJ)?

- a) 200 kJ b) 4.14×10^{-24} kJ c) 2.5×10^{-2} kJ d) 0.200 kJ e) 2.49 kJ

5] Which of the following is a wrong statement?

- a) H₂ gas behaves more ideally than CO₂ gas
b) CO₂ (44 g/mol) effuses faster than N₂(g) (28 g/mol) at STP
c) At the same temperature molecules of a gas with low molar mass have higher average velocity than heavier molecules
d) Average kinetic energy depends only on temperature
e) Real gases behaves as ideal gases at low pressure and high temperature

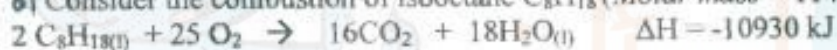
6] Calculate the root mean square velocity (u_{rms}) in (m/s) of CO_2 molecules in a sample of CO_2 gas at 1.0°C [molar mass of $\text{CO}_2 = 44.0 \text{ g/mol}$]

- a) 394 b) 44.0 c) 1.24 d) 39.2 e) 12.5

7] A gas is allowed to expand, at constant temperature, from a volume of 3.0 L to 8.0 L against external pressure of 1.10 atm. If the gas absorbs 350 J of heat from the surroundings, then ΔE in J:

- a) -345 b) +207 c) -907 d) +345 e) -207

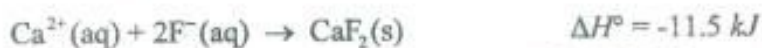
8] Consider the combustion of isooctane C_8H_{18} (Molar mass = 114 g/mol):



Calculate the energy released when 105 g of isooctane are combusted in excess oxygen?

- a) $2.19 \times 10^4 \text{ kJ}$ b) $1.01 \times 10^4 \text{ kJ}$ c) $5.03 \times 10^3 \text{ kJ}$ d) $2.52 \times 10^3 \text{ kJ}$ e) $2.01 \times 10^4 \text{ kJ}$

9] When 500.0 mL of 0.400 M $\text{Ca}(\text{NO}_3)_2$ is added to 500.0 mL of 0.800 M NaF, CaF_2 precipitates, as shown in the net ionic equation below. The initial temperature of both solutions is 20.00°C . Assuming that the resulting solution has a mass of 1000.00 g and a specific heat of $4.18 \text{ J/(g}\cdot^\circ\text{C)}$ calculate the final temperature of the solution.



- a) 18.90°C b) 20.00°C c) 19.45°C d) 20.55°C e) 21.10°C

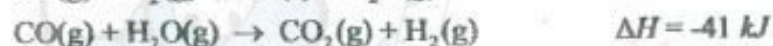
10] When 3.50 g of sucrose undergoes combustion in a *constant-volume* calorimeter, the temperature rises from 25.00 °C to 29.00 °C. Calculate ΔH for the combustion of sucrose in (kJ/mol) sucrose. The heat capacity of the calorimeter is 3.7 kJ/°C. The molar mass of sucrose is 342.3 g/mol.



- a) -5.07×10^3 b) -1.45×10^3 c) $+1.45 \times 10^3$ d) -1.48×10^1 e) $+1.48 \times 10^1$

11] For the following reaction: $2\text{C}(\text{s}) + 2\text{H}_2\text{O}(\text{g}) \rightarrow \text{CH}_4(\text{g}) + \text{CO}_2(\text{g})$ $\Delta H = ?$

Use the following information to find ΔH for the reaction above.



- a) -378 kJ b) 116 kJ c) 15 kJ d) -116 kJ e) -372 kJ

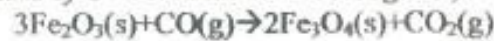
12] Using the information below, calculate ΔH_f° for PbO(s) in kJ/mol.



Molecules	ΔH_f° (kJ/mol)
CO(g)	-110.5
CO ₂ (g)	-393.5

- a) -413.9 kJ b) -151.6 kJ c) +372.1 kJ d) +413.9 kJ e) -372.1 kJ

13] Use the given standard enthalpies of formation to calculate the *heat released per gram* $\text{Fe}_2\text{O}_3(\text{s})$. (molar mass of $\text{O}=16.00$ and $\text{Fe}=55.85\text{g/mol}$)



Molecules	ΔH_f° (kJ/mol)
$\text{Fe}_2\text{O}_3(\text{s})$	-824.2
$\text{Fe}_3\text{O}_4(\text{s})$	-1118.4
$\text{CO}(\text{g})$	-110.5
$\text{CO}_2(\text{g})$	-393.5

- a) -98.5 kJ/g b) 98.5 kJ/mol c) -101.9 J/g d) -98.5 J/g e) +101.9 J/g

14] Calculate the energy (in joules) of 1 mole of photons with a wavelength of $10.00 \times 10^{-2} \text{ nm}$ (X ray region).

- a) $1.20 \times 10^9 \text{ J}$ b) $1.99 \times 10^{-24} \text{ J}$ c) $1.99 \times 10^{-15} \text{ J}$ d) $3.30 \times 10^{-19} \text{ J}$ e) 1.20 J

15] Calculate the wavelength (λ) of the light emitted by a hydrogen atom during a transition of its electron from the energy level with $n=2$ to the level with $n=1$.

- a) $1.0 \times 10^{-9} \text{ nm}$ b) 95.0 nm c) 122 nm d) 97.3 nm e) 103 nm

16] Calculate the frequency of a particle with mass = $1.00 \times 10^{-26} \text{ g}$ that is moving with a speed of $9.5 \times 10^2 \text{ cm/s}$.

- a) $1.4 \times 10^{12} \text{ s}^{-1}$ b) $4.3 \times 10^{19} \text{ s}^{-1}$ c) $4.3 \times 10^{16} \text{ s}^{-1}$ d) $4.3 \times 10^{14} \text{ s}^{-1}$ e) $1.4 \times 10^9 \text{ s}^{-1}$

Time: 60 min.

Student's Name:

Reg. No:

Section No.

Seat No.

#####@@

Physical constants and useful relations:1 atm = 101.3 kPa = 1.013×10^5 Pa = 760. Torr; Planck's constant = 6.63×10^{-34} J.s,Speed of light = 3.00×10^8 m/s; $E_n = -(2.18 \times 10^{-18}/n^2)$ J; $E = hc/\lambda$

R = 0.08206 L. atm/mol. K = 8.314 J / mol.K

; 1L. atm = 101.3 J;

 $\lambda = h/\mu$ Av. No. = 6.022×10^{23} mol⁻¹,

PV = n RT,

[P + a (n/V)²] (V - n b) = nRT $u_{rms} = (3RT/M)^{1/2}$; $\Delta E = q + w$, $\Delta H = \Delta E + P \times \Delta V$, $w = - P \times \Delta V$

#####

ANSWER SHEET

1. a b c d e 9. a b c d e

2. a b c d e 10. a b c d e

3. a b c d e 11. a b c d e

4. a b c d e 12. a b c d e

5. a b c d e 13. a b c d e

6. a b c d e 14. a b c d e

7. a b c d e 15. a b c d e

8. a b c d e 16. a b c d e

1. Which of the following statements concerning gases is *correct*?

- a) All gases behave ideally at high P and/or low T.
- b) No gases behave ideally at low P and/or high T.
- c) No gases behave ideally at high P and/or high T.
- d) All gases behave ideally at low P and/or high T
- e) Both *van der Waals* constants (a & b) are *the same* for all gases.

2. Which of the following statements concerning *ideal* gases is *incorrect (not correct)*?

- a) At constant n and T, $P_1 V_1 = P_2 V_2$.
- b) The average molecular speed is higher for H₂ gas than for N₂ gas at same T.
- c) The average kinetic energy is higher for H₂ gas than for N₂ gas at same T.
- d) At constant n, $P_1 V_1 / T_1 = P_2 V_2 / T_2$.
- e) At constant n and V, $P_1 / T_1 = P_2 / T_2$.

3. According to Kinetic Molecular Theory of gases, the root-mean square speed (u_{rms}) of N₂ gas (M = 28.0 g/mol) at 25°C is equal to

- a) 411 m/s b) 515 m/s c) 610. m/s d) 682 m/s e) 742 m/s

4. Given that the density for an ideal gas (d= 1.801 g/L) at 1.00 atm and 25°C, the molar mass (M in g/mol) of the gas is equal to

- a) 44.0 g/mol b) 30.0 g/mol c) 610. g/mol d) 58.0 g/mol e) 72.0 g/mol

5. The nitrogen (N₂) gas obtained from the decomposition of sodium azide (NaN₃) according to the chemical reaction: $2 \text{NaN}_3(\text{s}) \rightarrow 2 \text{Na}(\text{s}) + 3 \text{N}_2(\text{g})$ was collected over liquid water at a *total pressure* of 724 torr and 25°C where the vapor pressure of water was 24.0 torr. If the volume of the N₂ gas was 10.0 L, then the mass of N₂ gas is equal to.... (Molar mass of N₂ = 28.0 g/mole)

- a) 5.27 g b) 15.8. g c) 10.5 g d) 21.1 g e) 38.7 g

6. Given that 4.00 g of CH₄ gas (M = 16.0 g/mol) and 22.0 g of C₃H₈ gas (M = 44.0 g/mol) were placed in a 25.0 L container at 25°C, then the total pressure (P in kPa) of the gas mixture would be equal to

- a) 92.9 kPa b) 61.9 kPa c) 74.3 kPa d) 53.1 kPa e) 40.8 kPa

7. The combustion (oxidation) of propane (M = 44.0 g/mole) is described by the balanced equation

$$\text{C}_3\text{H}_{8(g)} + 5 \text{O}_{2(g)} \rightarrow 3 \text{CO}_{2(g)} + 4 \text{H}_2\text{O}_{(l)} \quad \Delta H = -2220 \text{ kJ}$$

 Calculate the mass of propane (in gram) must be burned to produce 175.5 kJ of heat.

- a- 6.96 b- 13.9 c- 20.9 d- 3.48 e- 4.40

8- Given the following data:



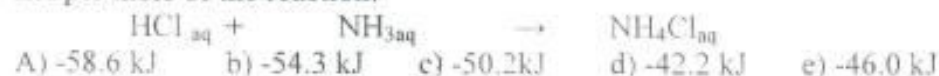
Calculate the standard enthalpy of combustion of benzene in (kJ/mole benzene)

- a) -3135.5 b) 6535.2 c) -6270.9 d) -3267.6 e) -6535.2

9- A gas is allowed to expand, at constant temperature, from a volume of 1.0 L to 10.1 L against an external pressure of 0.50 atm. If the gas absorbs 250 J of heat from the surroundings, what is the value of q, w, and ΔE?

	<u>q</u>	<u>w</u>	<u>ΔE</u>
a)	250 J	-4.55 J	245 J
b)	-250 J	-460 J	-710 J
c)	250 J	460 J	710 J
d)	-250 J	460 J	210 J
e)	250 J	-460 J	-210 J

10- A 100.0 ml of 0.200 M aqueous hydrochloric acid, is added to 100.0 ml of 0.200 M aqueous ammonia (NH₃) in a constant pressure calorimeter of negligible heat capacity. The initial temperature of both solutions is the same at 25.00 °C. The final temperature after mixing is 26.20 °C. Assuming the density of the solution = 1.00 g/ml and its specific heat = 4.18 J/g.°C, calculate ΔH per mole of the reaction:



- 11- given the following data
- | | $\Delta H(\text{kJ})$ |
|---|-----------------------|
| $\text{N}_{2(\text{g})} + 3/2 \text{O}_{2(\text{g})} \rightarrow \text{N}_2\text{O}_3$ | 83.7 |
| $\text{N}_{2(\text{g})} + \text{O}_{2(\text{g})} \rightarrow 2 \text{NO}(\text{g})$ | 180.4 |
| $1/2 \text{N}_{2(\text{g})} + \text{O}_{2(\text{g})} \rightarrow \text{NO}_2(\text{g})$ | 33.2 |
- Find $\Delta H(\text{kJ})$ for the reaction
- $$\text{NO}_2(\text{g}) + \text{NO}(\text{g}) \rightarrow \text{N}_2\text{O}_3$$
- a) - 19.7 b) - 59.7 c) 49.7 d) - 29.7 e) - 39.7

- 12 What is the wavelength (λ in nm) of a photon whose energy is 1.2×10^{-14} J
- a) 1.7×10^{12} b) 17 c) 1.7×10^{-1} d) 1.7×10^{-3} e) 1.7×10^{-2}

- 13 An electron transition of hydrogen atoms is accompanied with emission of light at 2165 nm. If the value of n_f for lower level involved in this emission is 4, what is the value of n_i for the higher level from which the electron falls back?

a) 5 b) 7 c) 3 d) 6 e) 4

- 14- For the electron configuration ($1s^2 2s^2 2p^4 3s^1$), how many electrons have the angular momentum quantum number ($l = 1$)?

a) 4 b) 1 c) 3 d) 2 e) 5

- 15 Calculate the wavelength (λ in meters) associated with an atom moving at a velocity of 1.0×10^5 m/s, given that the molar mass is 19.992 g/mol.

a- 1.0×10^{-12} b- 2.0×10^{-13} c- 1.0×10^{-14} d) 9.7×10^{-13} e- 2.0×10^{-14}

- 16- An atom with 23 electrons in its ground state will have..... unpaired electrons and is

a- 0, diamagnetic b- 2, diamagnetic c- 3, paramagnetic
d- 5, paramagnetic e- 7, paramagnetic

General Chem. 101
Second Exam

Date: 3/5/2008
Time: 60 min.

Name: Reg. No.:

Instructor Name: Seat No.:



$PV=nRT$, $\Delta U=q + w$, $R = 0.0821 \text{ atm L/mol. K}$, $h=6.63 \times 10^{-34} \text{ J.sec}$
 $1\text{m}=10^9 \text{ nm} = 10^{12} \text{ pm}$, $N = 6.022 \times 10^{23}$, $R = 8.314 \text{ J/mol.K}$,

$$U = \sqrt{\frac{3RT}{M}} , \quad E = hv , \quad \frac{1}{\lambda} = 1.097 \times 10^7 \text{ m}^{-1} \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right) , \quad C = 3.0 \times 10^8 \frac{\text{m}}{\text{sec}}$$



ANSWER SHEET

- | | | | | | | | | | | | |
|----|---|---|---|---|---|-----|---|---|---|---|---|
| 1. | a | b | c | d | e | 9. | a | b | c | d | e |
| 2. | a | b | c | d | e | 10. | a | b | c | d | e |
| 3. | a | b | c | d | e | 11. | a | b | c | d | e |
| 4. | a | b | c | d | e | 12. | a | b | c | d | e |
| 5. | a | b | c | d | e | 13. | a | b | c | d | e |
| 6. | a | b | c | d | e | 14. | a | b | c | d | e |
| 7. | a | b | c | d | e | 15. | a | b | c | d | e |
| 8. | a | b | c | d | e | 16. | a | b | c | d | e |

1. Calculate the number of grams of KMnO_4 (MW = 158.0) in 3.00 liters of a 0.250 M solution

- a) 191 b) 75.0 c) 119 d) 139 e) 169

2. A 0.6025 g-sample of a chloride salt was dissolved in water and the chloride precipitated by adding excess silver nitrate (MW=169.87). The precipitate of silver chloride (MW = 143.32) was filtered, washed, dried, and found to have a mass of 0.7134 g. Calculate the mass percentage of chloride (A.W = 35.45) in the sample.

- a) 20.89 b) 22.81 c) 24.73 d) 29.29 e) 31.57

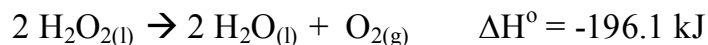
3. How many degrees of temperature rise (in $^{\circ}\text{C}$) will occur when a 25.0 g block of aluminum absorbs 0.338 kJ of heat? The specific heat of Al is $0.900 \text{ J/g} \cdot ^{\circ}\text{C}$

- a) 22.2 b) 3.60 c) 15.0 d) 5.75 e) 11.4

4. When gasoline burns in a car engine, heat is released and $\text{CO}_{2(g)}$ and $\text{H}_2\text{O}_{(g)}$ are produced. If the resulting gases do 236 J of work on the surrounding, and the system loses 437 J to the surrounding as heat, calculate the change in internal energy, ΔU , of the system.

- a) 673 J b) -673 J c) 201 J d) -201 J e) 776 J

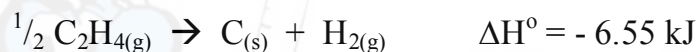
5. Liquid hydrogen peroxide decomposes at constant pressure according to the following thermochemical equation



How much heat is released when 14.64 g $\text{H}_2\text{O}_{2(l)}$ (molar mass = 34.0 g/mol) decomposes?

- a) 196.1 kJ b) 98.1 kJ c) 21.1 kJ d) 42.2 kJ e) 114.2 kJ

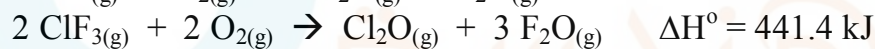
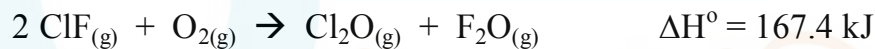
6. Given the following thermochemical equation



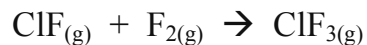
The enthalpy of formation of $\text{C}_2\text{H}_{4(g)}$ [$\Delta H^\circ_f(\text{C}_2\text{H}_{4(g)})$] is

- a) +13.1 kJ b) -26.2 kJ c) -52.4 kJ d) -13.1 kJ e) +52.4 kJ

7. The following heats of reaction are known



Using Hess's law, calculate ΔH° (in kJ) for the reaction:



- a) -130.2 b) 108.7 c) -217.5 d) 217.5 e) -158.7

8. What is the correct electronic configuration of silver Ag ($Z = 47$)?
- a) $[\text{Kr}] 5s^2 4d^9$
 - b) $[\text{Kr}] 5s^2 5d^9$
 - c) $[\text{Kr}] 4s^1 3d^{10}$
 - d) $[\text{Kr}] 5s^2 4d^{10}$
 - e) $[\text{Kr}] 5s^1 4d^{10}$
9. Which of the following elements is considered a paramagnetic substance
- a) Hg(80) b) Ba(56) c) Ru(44) d) Cd(48) e) Sr(38)
10. A 2.56 g of a colorless liquid was vaporized in a 250 mL flask at 121°C and 786 mmHg. What's the molecular weight of this liquid.
- a) 3.2×10^2 g/mol b) 6.3×10^2 g/mol c) 125 g/mol
 - d) 2.0×10^2 g/mol e) 5.1×10^2 g/mol
11. In alcohol fermentation, yeast converts glucose to ethanol and carbon dioxide:
- $$\text{C}_6\text{H}_{12}\text{O}_{6(s)} \rightarrow 2 \text{C}_2\text{H}_5\text{OH}_{(l)} + 2 \text{CO}_{2(g)}$$
- If 5.97 g of glucose (MW = 180.2) are reacted and 1.44 L of CO_2 gas are produced at 293 K and 0.984 atm, what is the percent yield of the reaction?
- a) 60.5% b) 10.2% c) 88.9% d) 95.1% e) 40.4%
12. If 0.10 mole of I_2 (MW = 253.8) vapor can effuse from an opening in a heated vessel in 39 seconds, how long will it take 0.10 mole of H_2 (MW = 2.016) to effuse under the same conditions?
- a) 9.5 s b) 3.5 s c) 1.8 s d) 5.3 s e) 15.3 s

13. A mixture of helium and neon gases is collected over water at 28 °C and 745 mmHg. If partial pressure of helium is 368 mmHg, what is the partial pressure of neon? (vapor pressure of water at 28 °C = 28.3 mmHg).

- a) 349 mmHg b) 214 mmHg c) 504 mmHg
d) 150 mmHg e) 501 mmHg

14. What is the energy in Joules, of one photon of X-ray radiation with wavelength of 0.158 nm.

- a) 3.14×10^{-26} J b) 1.48×10^{-24} J c) 3.19×10^{-25} J
d) 7.15×10^{40} J e) 1.26×10^{-15} J

15. Calculate the frequency of the light emitted by hydrogen atom during a transition of its electron from the energy level with $n=4$ to the energy level with $n=1$.

- a) $1.028 \times 10^7 \text{ s}^{-1}$ b) $1.215 \times 10^{-7} \text{ s}^{-1}$ c) $2.467 \times 10^{15} \text{ s}^{-1}$
d) $3.083 \times 10^{15} \text{ s}^{-1}$ e) $8.228 \times 10^6 \text{ s}^{-1}$

16. Given the following sets of quantum numbers for (n, l, m_l, m_s) , which set is not a possible set of quantum numbers for an electron in an atom?

- | | n | l | m_l | m_s |
|----|---|---|-------|----------------|
| a) | 4 | 2 | 2 | $-\frac{1}{2}$ |
| b) | 3 | 1 | -1 | -1 |
| c) | 4 | 3 | 2 | $\frac{1}{2}$ |
| d) | 4 | 3 | -2 | $-\frac{1}{2}$ |
| e) | 5 | 2 | -2 | $\frac{1}{2}$ |



chemistry 1



second exams

عندما تطمح في شيء وتسعى جادا في الحصول
عليه.. فإن العالم بأسره يكون في صفك
باولو كويلو

13

General Chem. 101

Time: 60 min.

Second Exam

Date: 19/12/2009

Student's Name:

Reg. No:

Section No. ٤٠٣ يوم الأحد د. مالك القادري

Seat No. 51.....

#####@@#####

Physical constants and useful relations:

1 atm = 101.3 kPa = 1.013 x 10⁵ Pa = 760. Torr; Planck's constant = 6.63x10⁻³⁴ J.s,

Speed of light = 3.00 x10⁸ m/s; E_n = - (2.18 x10⁻¹⁸/n²) J; E = hc/λ

R = 0.08206 L. atm/mol. K = 8.314 J / mol.K ; 1L. atm = 101.3 J; λ = h/mu

Av. No. = 6.022 x 10²³ mol⁻¹, PV = n RT, [P + a (n/V)²] (V - n b) = nRT

u_{rms} = (3RT/M)^{1/2}; ΔE = q + w, ΔH = ΔE + P x ΔV, w = - P x ΔV

#####@@#####

ANSWER SHEET

- | | |
|------------------------------------|-------------------------------------|
| 1. a b c d e | 9. a b c d e |
| 2. a b c d e | 10. a b c d e |
| 3. a b c d e | 11. a b c d e |
| 4. a b c d e | 12. a b c d e |
| 5. a b c d e | 13. a b c d e |
| 6. a b c d e | 14. a b c d e |
| 7. a b c d e | 15. a b c d e |
| 8. a b c d e | 16. a b c d e |

1. Which of the following statements concerning gases is *correct*?

- a) All gases behave ideally at high P and/or low T.
- b) No gases behave ideally at low P and/or high T.
- c) No gases behave ideally at high P and/or high T.
- d) All gases behave ideally at low P and/or high T
- e) Both *van der Waals* constants (a & b) are *the same* for all gases.

real
T → low
P → high

Ideal
T → high
P → low

2. Which of the following statements concerning *ideal* gases is *incorrect* (*not correct*)?

- a) At constant n and T, $P_1 V_1 = P_2 V_2$.
- b) The average molecular speed is higher for H₂ gas than for N₂ gas at same T.
- c) The average kinetic energy is higher for H₂ gas than for N₂ gas at same T.
- d) At constant n, $P_1 V_1 / T_1 = P_2 V_2 / T_2$.
- e) At constant n and V, $P_1 / T_1 = P_2 / T_2$.

3. According to Kinetic Molecular Theory of gases, the root-mean square speed (u_{rms}) of N₂ gas (M = 28.0 g/mol) at 25°C is equal to

- a) 411 m/s
- b) 515 m/s
- c) 610. m/s
- d) 682 m/s
- e) 742 m/s

$$u_{rms} = \sqrt{\frac{3RT}{M}} = \sqrt{\frac{3 \cdot 298 \cdot 8.314}{28 \cdot 10^{-3}}}$$

4. Given that the density for an ideal gas (d = 1.801 g/L) at 1.00 atm and 25°C, the molar mass (M in g/mol) of the gas is equal to

- a) 44.0 g/mol
- b) 30.0 g/mol
- c) 610. g/mol
- d) 58.0 g/mol
- e) 72.0 g/mol

$$M = \frac{dRT}{P}$$

$$M = \frac{1.801 \cdot 0.0821 \cdot 298}{1}$$

$$M = \frac{dRT}{P}$$

5. The nitrogen (N₂) gas obtained from the decomposition of sodium azide (NaN₃) according to the chemical reaction: $2 \text{NaN}_3(\text{s}) \rightarrow 2 \text{Na}(\text{s}) + 3 \text{N}_2(\text{g})$ was collected over liquid

water at a *total pressure* of 724 torr and 25°C where the vapor pressure of water was 24.0 torr. If the volume of the N₂ gas was 10.0 L, then the mass of N₂ gas is equal to.... (Molar mass of N₂ = 28.0 g/mole)

- a) 5.27 g
- b) 15.8. g
- c) 10.5 g
- d) 21.1 g
- e) 38.7 g

$$m = \frac{P \cdot V \cdot M}{R \cdot T} = \frac{(724 - 24) \cdot 10 \cdot 28}{0.0821 \cdot 298}$$

$$P = \frac{nRT}{V}$$

$$\frac{m}{M}$$

$$724 - 24 = 700$$

$$700 \cdot 10 \cdot 28 = 196000$$

$$196000 / (0.0821 \cdot 298) = 8125$$

$$8125 / 28 = 290$$

$$P = \frac{nRT}{V} \rightarrow \frac{298 \times 0.082 \times 7.7}{25}$$

6. Given that 4.00 g of CH₄ gas (M = 16.0 g/mol) and 22.0 g of C₃H₈ gas (M = 44.0 g/mol) were placed in a 25.0 L container at 25°C, then the total pressure (P in kPa) of the gas mixture would be equal to

$$P = \frac{nRT}{V} = \frac{1.75 \times 0.082 \times 298}{25} = 1.7 \text{ atm}$$

1.7 atm $\times \frac{101.3 \text{ kPa}}{1 \text{ atm}}$

- a) 92.9 kPa b) 61.9 kPa **c) 74.3 kPa** d) 53.1 kPa e) 40.8 kPa

7- The combustion (oxidation) of propane (M = 44.0 g/mole) is described by the balanced equation
 $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(l) \quad \Delta H = -2220 \text{ kJ}$
 Calculate the mass of propane (in gram) must be burned to produce 175.5 kJ of heat.

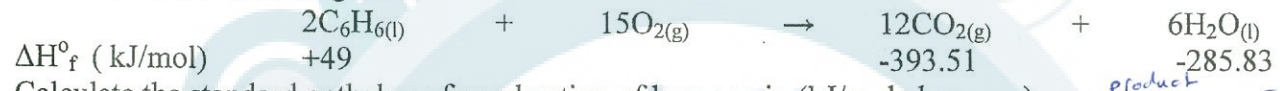
- a- 6.96 ~~b- 13.9~~ c- 20.9 d- 3.48 e- 4.40

$$\frac{2220}{n} = 175.5$$

$$n = \frac{2220}{175.5} = 12.6$$

$$12.6 \times 44 = 554.4 \text{ g}$$

8- Given the following data:



Calculate the standard enthalpy of combustion of benzene in (kJ/mole benzene)

- a) -3135.5 b) 6535.2 c) -6270.9 **d) -3267.6** ~~e) -6535.2~~

product - reactant

$$(12 \times -393.51 + 6 \times -285.83) - (2 \times 49)$$

$$-4722.12 - 98 = -4820.12$$

product - reactant

$$6 \times -285.83 + 12 \times -393.51 - 2 \times 49$$

$$-1714.98 - 4722.12 - 98 = -6535.2$$

9- A gas is allowed to expand, at constant temperature, from a volume of 1.0 L to 10.1 L against an external pressure of 0.50 atm. If the gas absorbs 250 J of heat from the surroundings, what is the value of q, w, and ΔE?

	q	w	ΔE
a)	250 J	-4.55 J	245 J
b)	-250 J	-460 J	-710 J
c)	250 J	460 J	710 J
d)	-250 J	460 J	210 J
e)	250 J	-460 J	-210 J

$w = -P\Delta V$

$$w = -0.5 \times (10.1 - 1.0) \text{ atm} \times 101.3$$

$$w = -460.9 \text{ J}$$

q = +250 J

$$\Delta E = q + w = 250 - 460.9 = -210.9 \text{ J}$$

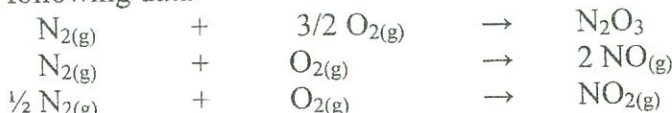
10- A 100.0 ml of 0.200 M aqueous hydrochloric acid, is added to 100.0 ml of 0.200 M aqueous ammonia (NH₃) in a constant pressure calorimeter of negligible heat capacity. The initial temperature of both solutions is the same at 25.00 °C. The final temperature after mixing is 26.20 °C. Assuming the density of the solution = 1.00 g/ml and its specific heat = 4.18 J/g.°C, calculate ΔH per mole of the reaction:



$$q = m s \Delta T$$

$$q = 200 \times 4.18 \times (1.20)$$

11- given the following data



$\Delta H(\text{kJ})$
83.7
180.4
33.2

Find $\Delta H(\text{kJ})$ for the reaction



a) -19.7

b) -59.7

c) 49.7

d) -29.7

e) -39.7

$$-33.2$$

$$\frac{-180.4}{2} = -90.2$$

12 What is the wavelength (λ in nm) of a photon whose energy is $1.2 \times 10^{-14} \text{ J}$

$$\lambda = \frac{hc}{E}$$

a) 1.7×10^{-12}

b) 17

c) 1.7×10^{-1}

d) 1.7×10^{-3}

e) 1.7×10^{-2}

$$E = \frac{hc}{\lambda}$$

$$\lambda = \frac{hc}{E} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{1.2 \times 10^{-14}} = 16.575 \times 10^{-9} \text{ m} = 16.575 \text{ nm} \approx 17 \text{ nm}$$

$$16.575 \text{ nm} \approx 17 \text{ nm}$$

$$\frac{17 \times 10^{-9} \text{ m}}{10^{-9} \text{ m}} = 17$$

$$\frac{-34 + 8}{-14} = -2.428 \approx -2.4$$

13 An electron transition of hydrogen atoms is accompanied with emission of light at 2165 nm. If the value of n_f for lower level involved in this emission is 4, what is the value of n_i for the higher level from which the electron falls back?

a) 5

b) 7

c) 3

d) 6

e) 4

$$\frac{6.63 \times 10^{-34} \times 3 \times 10^8}{2165 \times 10^{-9}} = 9.18 \times 10^{-17} \text{ J}$$

$$-17$$

$$\frac{4}{2} = 2$$

$$9.18 \times 10^{-17} = 2.18 \times 10^{-18} \left(\frac{1}{n_f^2} - \frac{1}{n_i^2} \right)$$

$$E = \frac{hc}{\lambda} = \frac{6.63 \times 10^{-34} \times 3 \times 10^8}{2165 \times 10^{-9}} = 9.18 \times 10^{-17} \text{ J}$$

14 For the electron configuration $(1s^2 2s^2 2p^4 3s^1)$, how many electrons have the angular momentum quantum number ($l = 1$)?

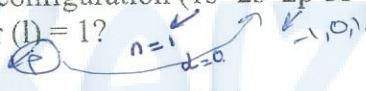
a) 4

b) 1

c) 3

d) 2

e) 5



$$l = 1$$

15 Calculate the wavelength (λ in meters) associated with an atom moving at a velocity of $1.0 \times 10^5 \text{ m/s}$, given that the molar mass is 19.992 g/mol . \times Avogadro num

a) 1.0×10^{-12}

b) 2.0×10^{-13}

c) 1.0×10^{-14}

d) 9.7×10^{-13}

e) 2.0×10^{-14}

$$\lambda = \frac{h}{m \cdot v} = \frac{6.63 \times 10^{-34}}{19.992 \times 10^{-3} \text{ kg} \cdot 1.0 \times 10^5 \text{ m/s}} = 3.31 \times 10^{-13} \text{ m}$$

$$\lambda = \frac{h}{m \cdot v} = \frac{6.63 \times 10^{-34}}{19.992 \times 10^{-3} \times 1.0 \times 10^5} = 3.31 \times 10^{-13} \text{ m}$$

16- An atom with 23 electrons in its ground state will have..... unpaired electrons and is

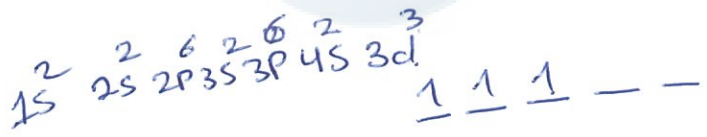
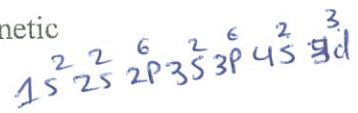
a) 0, diamagnetic

b) 2, diamagnetic

c) 3, paramagnetic

d) 5, paramagnetic

e) 7, paramagnetic



11/16

The University of Jordan
Date: 12/12/2010

General Chemistry 101
Second Exam

Chemistry Department
Time: 60 min.

Name: _____ Registration Number _____

Instructor _____ Seat No. _____ Day/Time _____

Answer Sheet

$K = ^\circ\text{C} + 273$, $1 \text{ atm} = 760 \text{ mmHg}$, $R = 0.082057 \text{ L}\cdot\text{atm}/(\text{K}\cdot\text{mol}) = 8.314 \text{ J}/(\text{K}\cdot\text{mol})$, $L\cdot\text{atm} = 101.3 \text{ J}$, $N_A = 6.022 \times 10^{23}$, $h = 6.63 \times 10^{-34} \text{ J}\cdot\text{s}$, $R_H = 2.18 \times 10^{-18} \text{ J}$,

$c = 3 \times 10^8 \text{ m/s}$, $PV = nRT$, $u_{\text{rms}} = \sqrt{u^2} = \sqrt{\frac{3RT}{M}}$, $KE = \frac{3}{2}RT = N_A(\frac{1}{2}mu^2)$, $\Delta E = \Delta H - P\Delta V$

$\Delta E = q + w$, $c = \lambda\nu$, $E = h\nu$, $E_n = -R_H(1/n^2)$, $\lambda = h/(mu)$,

1. a b c d e 9. a b c ~~d~~ e

2. a b c d e 10. a b c d e

3. a b c d e 11. a b c d e

4. a b c d e 12. a b c d e

5. a ~~b~~ c d e 13. a b c ~~d~~ e

6. a b c d e 14. ~~a~~ b c d e

7. a b c d ~~e~~ 15. a b c d e

8. a b c d e 16. a b c d e

$$P = \frac{nRT}{V}$$

$$n = \frac{m}{MM}$$

$$n = 0.018$$

$$n = \frac{PV}{RT} = \frac{1 \times 0.401}{0.082057 \times 273.15}$$

1] Determine the molar mass of a gas if 0.401 L weighs 1.55g at STP?

- a) 69.3 g/mol b) 94.5 g/mol **c) 86.6 g/mol** d) 53.3 g/mol e) 43.3 g/mol

$$P_t = P_{H_2} + P_{H_2O} \rightarrow P_{H_2} = 988 - 118 = 870 \text{ mm Hg}$$

2] In a reaction of calcium metal with water, the volume of hydrogen gas collected at 50°C and pressure of 988 mmHg is 441 mL. What is the mass (in grams) of the hydrogen gas obtained? The vapor pressure of water at 50°C is 118 mmHg. (Molar mass of H₂ = 2.016 g/mol)

- a) 0.0436g **b) 0.0384g** c) 0.0190g d) 0.0242g e) 0.0488g

$$n = \frac{PV}{RT} =$$

3] Calculate the mass of calcium (in g) that must be dissolved in sulfuric acid in order to obtain 500ml of hydrogen gas at 20°C and 770 mmHg? (Molar mass of Ca = 40.08 g/mol)

- ~~$P_{H_2} = P_t - P_{H_2O}$~~ a) 1.38 g **b) 0.0425 g** c) 1.24 g **d) 0.84 g** e) 1.18 g

$$n = \frac{PV}{RT} = \frac{770 \times 0.500}{0.082057 \times (20 + 273)}$$

4] What is the kinetic energy of a mole of CO₂ at 200K (in kJ)?

- a) 200 kJ b) 4.14x10⁻²⁴ kJ c) 2.5x10⁻² kJ d) 0.200 kJ **e) 2.49 kJ**

~~$\frac{3RT}{2} = \frac{3 \times 8.314 \times 200}{2} = 2494.2 \text{ J} = 2.49 \text{ kJ}$~~

$KE = \frac{1}{2} m v^2$

$\frac{3}{2} R T \text{ K}$
K. mol.
L. atm

5] Which of the following is a wrong statement?

- a) H₂ gas behaves more ideally than CO₂ gas
 b) CO₂ (44 g/mol) effuses faster than N₂(g) (28 g/mol) at STP
 c) At the same temperature molecules of a gas with low molar mass have higher average velocity than heavier molecules
d) Average kinetic energy depends only on temperature.
 e) Real gases behaves as ideal gases at low pressure and high temperature

$$P_1 V_1 = P_2 V_2$$

$$u_{rms} = \sqrt{\frac{3RT}{MM}} = \sqrt{\quad}$$

6] Calculate the root mean square velocity (u_{rms}) in (m/s) of CO_2 molecules in a sample of CO_2 gas at $1.0^\circ C$ [molar mass of $CO_2 = 44.0 \text{ g/mol}$]

- a) 394 b) 44.0 c) 1.24 d) 39.2 e) 12.5

7] A gas is allowed to expand, at constant temperature, from a volume of 3.0 L to 8.0 L against external pressure of 1.10 atm. If the gas absorbs 350 J of heat from the surroundings, then ΔE in J:

- a) -345 b) +207 c) -907 d) +345 e) -207

$$\Delta E = \Delta H - P\Delta V$$

$$\Delta E = q + w$$

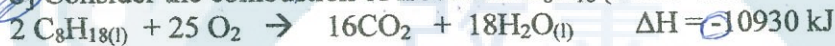
$$w = -P\Delta V$$

$$w = -1.10 \times (8 - 3)$$

$$\Delta V > 0$$

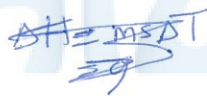
$$w = -$$

8] Consider the combustion of isooctane C_8H_{18} (Molar mass = 114 g/mol):



Calculate the energy released when 105 g of isooctane are combusted in excess oxygen?

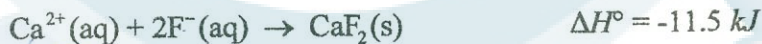
- a) $2.19 \times 10^4 \text{ kJ}$ b) $1.01 \times 10^4 \text{ kJ}$ c) $5.03 \times 10^3 \text{ kJ}$ d) $2.52 \times 10^3 \text{ kJ}$ e) $2.01 \times 10^4 \text{ kJ}$



$$\Delta E = q + w$$

$$\Delta H = H_f$$

9] When 500.0 mL of 0.400 M $Ca(NO_3)_2$ is added to 500.0 mL of 0.800 M NaF, CaF_2 precipitates, as shown in the net ionic equation below. The initial temperature of both solutions is $20.00^\circ C$. Assuming that the resulting solution has a mass of 1000.00 g and a specific heat of $4.18 \text{ J/(g}\cdot^\circ C)$ calculate the final temperature of the solution.



- a) $18.90^\circ C$

- b) $20.00^\circ C$

- c) $19.45^\circ C$

- d) $20.55^\circ C$

- e) $21.10^\circ C$

$Ca(NO_3)_2$
500 mL
0.400 M

+ NaF
500 mL
0.8 M

$m_{sol} = 1000 \text{ g}$
 $S = 4.18$

$20^\circ C$

$$q = m s \Delta T$$

$$2.395 \times 10^{-3} = \Delta T$$

$$TF = 20$$

$$11.5 = 1000 \times 4.18 \times (TF - 20)$$

10] When 3.50 g of sucrose undergoes combustion in a constant-volume calorimeter, the temperature rises from 25.00 °C to 29.00 °C. Calculate ΔH for the combustion of sucrose in (kJ/mol) sucrose. The heat capacity of the calorimeter is 3.7 kJ/°C. The molar mass of sucrose is 342.3 g/mol.

Bomb

$\Delta H = -$

- $C_{12}H_{22}O_{11}(s) + 12O_2(g) \rightarrow 12CO_2(g) + 11H_2O(l)$
- a) -5.07×10^3 b) -1.45×10^3 c) $+1.45 \times 10^3$ d) -1.48×10^1 e) $+1.48 \times 10^1$

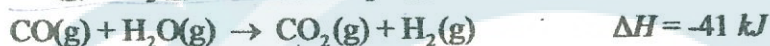
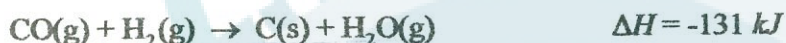
$$q = C \Delta T$$

$$= 3.7 \times (29 - 25)$$

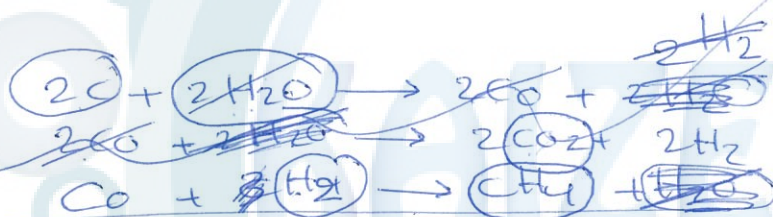
$$= 14.8 \text{ kJ}$$

11] For the following reaction: $2C(s) + 2H_2O(g) \rightarrow CH_4(g) + CO_2(g)$ $\Delta H = ?$

Use the following information to find ΔH for the reaction above.



- a) -378 kJ b) 116 kJ c) 15 kJ d) -116 kJ e) -372 kJ



$$\Delta H = 2(131)$$

$$\Delta H = 2(-41)$$

$$\Delta H = -206$$

12] Using the information below, calculate ΔH_f° for PbO(s) in kJ/mol.

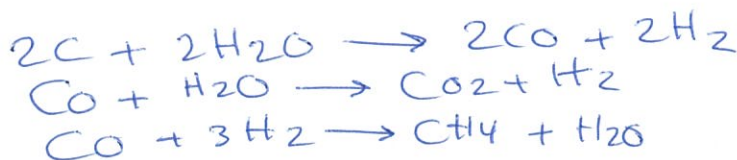
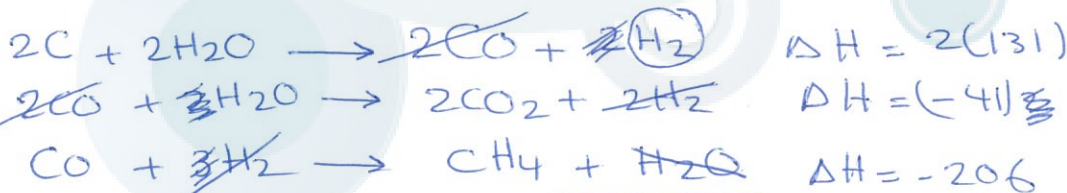


Molecules	ΔH_f° (kJ/mol)
CO(g)	-110.5
CO ₂ (g)	-393.5

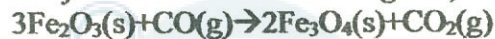
$$\Delta H_{rxn}^\circ = 1 \times \Delta H_f^\circ(CO_2) - \Delta H_f^\circ(CO) - \Delta H_f^\circ(PbO)$$

$$-131.4 = -393.5 + 110.5 - \Delta H_f^\circ(PbO)$$

- a) -413.9 kJ b) -151.6 kJ c) +372.1 kJ d) +413.9 kJ e) -372.1 kJ



13] Use the given standard enthalpies of formation to calculate the heat released per gram Fe₂O₃(s). (molar mass of O=16.00 and Fe=55.85g/mol)



Molecules	ΔH_f° (kJ/mol)
Fe ₂ O ₃ (s)	-824.2
Fe ₃ O ₄ (s)	-1118.4
CO(g)	-110.5
CO ₂ (g)	-393.5

- a) -98.5 kJ/g b) 98.5 kJ/mol **c) -101.9 J/g** d) -98.5 J/g e) +101.9 J/g

14] Calculate the energy (in joules) of 1 mole of photons with a wavelength of 10.00×10^{-2} nm (X ray region).

- a) 1.20×10^9 J b) 1.99×10^{-24} J **c) 1.99×10^{-15} J** d) 3.30×10^{-39} J e) 1.20 J

$$\Delta E = h \frac{c}{\lambda}$$

$$c = \nu \lambda$$

15] Calculate the wavelength (λ) of the light emitted by a hydrogen atom during a transition of its electron from the energy level with $n=2$ to the level with $n=1$.

- a) 1.0×10^{-9} nm b) 95.0 nm **c) 122 nm** d) 97.3 nm e) 103 nm

$$\Delta E = -2.18 \times 10^{-18} \left(\frac{1}{1^2} - \frac{1}{2^2} \right)$$

$$\Delta E = -1.635 \times 10^{-18}$$

$$\lambda =$$

16] Calculate the frequency of a particle with mass = 1.00×10^{-26} kg that is moving with a speed of 9.5×10^2 cm/s.

- a) 1.4×10^{12} s⁻¹ b) 4.3×10^{19} s⁻¹ **c) 4.3×10^{16} s⁻¹** d) 4.3×10^{14} s⁻¹ e) 1.4×10^9 s⁻¹

$$\lambda = \frac{h}{m \nu}$$

$$\text{kg} \frac{\text{m}}{\text{s}}$$

$$\lambda = 6.978 \times 10^{-11}$$

$$\Delta E = h \nu$$

$$\text{J}$$

kg.